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ORGANIZATION OF THE HYDROLOGICAL SERVICE AND
HYDROLOGICAL STUDIES IN THE SOVIET UNION

by Z. Kaczmarek

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ORGANIZATION OF THE HYDROLOGICAL SERVICE AND
HYDROLOGICAL STUDIES IN THE SOVIET UNION

[Following is a translation of an article by Z. Kaczmarek in the Polish-language periodical Przegląd Geofizyczny (d. Przegląd Meteorologiczny i Hydrologiczny) (Geophysical Review, formerly Meteorological and Hydrological Review), Warsaw, No. 1, January 1960, pages 77-82.]

General remarks. During a visit of several months to the Soviet Union I had the opportunity to become familiar with the organization of the hydrological service in that country. Thanks to the kindness of my hosts, and particularly of the employees of the State Hydrological Institute in Leningrad, I obtained much valuable data, allowing me to acquire a general view of the studies being conducted in the field of hydrology in the Soviet Union. Detailed discussion of these activities would require a number of special articles. The remarks presented below have, as their aim, only to acquaint the reader of the general organizational principles in the hydrological service.

Basic research in the field of hydrology, meteorology and oceanography is conducted in the Soviet Union by a combined hydrological and meteorological service under the direct control of the Council of Ministers. In this way, the needs of the various economic sectors can be equally served. The general organizational scheme is represented in Diagram 1. A characteristic feature of this organization is the confining of scientific research to a separate hierarchically organized group represented by a number of specialized institutes. Until recently the hydrological service also owned establishments for the production of measuring equipment and other auxiliary units (for example, a printing house). Recently, within the framework of general reorganization of the Soviet Union's national economy, these production units were transferred to operate directly under the regional management of the National Economic Councils, still working, however, for the hydrological service. We shall discuss below the following problems:

- a. Organization of mass hydrological stations.
- b. Organization of scientific research in hydrology.
- c. Problems of personnel training.

Hydrological Service. The network of stations of hydrological mass observations was planned in the Soviet Union according to the representational method. The size of the country obviously makes it impossible to conduct research on all rivers (their number reaches 100,000), lakes and other water areas. Thus, field observation stations should be distributed in such a way that, on the basis of the obtained results, it would be possible to make corresponding generalizations for the whole country (empirical formulae, isolines of separate elements, and the like). Many articles were devoted to the problem of planning the network, among which we mention only those written by Alekin (1), Borsuk (3), Shanov (6), Ushanov (10), and Uryvaev (11).

In the year 1946 the so-called plan of optimal development for the basic hydrological network was prepared on the basis of the representational method. Planned at that time were 10,100 water gaging stations (of which, 9,000 were for the systematic measuring of the flow of water) for comprehensive research on hydrological relations; in addition, it was planned to build 400 stations on lakes and a certain number of special stations (on marshes, for water balance calculation, and the like). In recent times, opinions are being expressed, proposing a decrease in the above-mentioned optimal figures, primarily by means of a broader application of the seasonal work of certain field stations. According to that concept, the basic hydrological network would be divided into:

- a. Permanent observation stations designed for long term observations,
- b. Seasonal field stations, conducting observations for at least 10 years, which would be abolished after the respective hydrological relations between them and the permanent stations had been determined.

The total number of temporary stations would not change during this time, but their locations would change.

At the present time, the basic hydrological network consists of about 5,600 water gaging stations on rivers. Out of this number, in 4,000 stations the systematic measuring of the flow of water is conducted in order to determine daily magnitudes. The number of limnographs (limnimeters) is relatively small and amounts to about 300; however, the construction within a short time of 450 additional limnographs is being planned. Ice and thermic phenomena are surveyed at each station. In 730 stations bathymetric observations are conducted (limited to the problem of transportation of suspended load of sedimentary material), and in 800 stations chemical analyses are conducted.

The scheme and scope of surveys in stations and field stations of the hydrological and meteorological service is illustrated by Diagram 2. The work of the network is based on the system of

hydrological stations which employ permanent and scientific personnel. A number of field stations are subordinate to each station (including also the field station which is a part of that station). The maximum number of field stations under the supervision of one station is about 30. The basic tasks of the station personnel include:

a. Training and supervision of observers at subordinate field stations.

b. Conducting more advanced surveys; for example, triangulation, measurement of the flow of water under more difficult conditions, chemical analysis of water, and the like.

c. Preparation of observational materials received from all subordinate field stations (such as water stages, consumption curves, daily flow of water, transportation of suspended load of sedimentary materials, and the like).

d. Preparation of materials for hydrological yearbooks.

The obligation of station employees to analyze survey materials and prepare yearbooks had a favorable influence on the quality of survey works conducted within the network.

Observations on water gaging stations are conducted by the temporary personnel. The tasks of the observer are generally far greater than those in the Polish hydrological service. He is, for example, obliged to measure independently the flow of water at low and medium stages (excluding obviously big rivers). At the present time observers are recruited exclusively from among secondary school graduates.

It follows from the above remarks that the Soviet observation network is decentralized to a high degree. The whole burden of survey activities rests on stations and field stations. Bureaus of the service in the republics and regions (corresponding to branches of the State Hydrological and Meteorological Institute in Poland) have as their tasks the training of personnel and supervision of work conducted by the network units and compiling surveys for larger areas. They also do the planning of the network in areas under their supervision. Advanced decentralization, however, requires complete uniformity of methodology in surveys and in studies. Detailed instructions and directives, therefore, have been issued for stations and field stations (4,5) and are in force throughout the whole Soviet Union. Shortage of space does not allow me to discuss the methodological aspects of the Soviet hydrological service. In the directives mentioned, one may find much valuable material on this subject, based on the results of comprehensively planned meteorological studies conducted in the scientific institutes subordinate to the hydrological service.

It should be mentioned that the above remarks pertain to the basic network of the hydrological and meteorological service. In addition, there exists in the Soviet Union special group networks organized from time to time for special purposes in connection with planning and carrying out hydrotechnical activities

and also for other practical purposes. The results of observations obtained at the field stations of special networks are not used for the analysis of hydrological relations in a given area, and are mainly useful for the institution which directs these stations. Observations from certain field stations are included in yearbooks published by the hydrological survey. It is worth-while to note that the hydrological service in the German Democratic Republic has been organized in a similar way.

Scientific research. As we have already mentioned, the Soviet hydrological service conducts scientific research in the subordinate research institutes. I gained the impression that the main weight of scientific research in hydrology and meteorology conducted in the Soviet Union at the present time rests upon these institutes. A relatively minor role is played by the academic schools and the Institutes of the Academy of Sciences. The range of problems centers around the following basic problems:

- a. Determination of methodology of surveys for the networks of hydrological mass observations.
- b. Detailed analysis of processes taking place in the hydrosphere, based upon researches in specialized field laboratories.
- c. Generalization of the results obtained on the network stations in order to determine hydrological relations in the whole country (empirical formulae, isolines).
- d. Development of methodology of weather forecasting and of hydrological calculations.

It should be emphasized that many scientific studies are based on extensive experimental material gathered in field stations and during scientific expeditions.

The following scientific institutes are chiefly interested in hydrological problems:

- a. The State Hydrological Institute (GGI) in Leningrad - interested in almost all problems of water circulation in nature.
- b. The Central Weather Institute (Ts. I. P.) in Moscow where, in addition to the methodology of weather forecasting, investigation as to the processes of hydrological phenomena are conducted.
- c. The Central Geophysical Observatory (GGO) in Leningrad investigates the influence of climate on the circulation of water (precipitation, evaporation, and the like).
- d. The Institute of Instrument Construction in Moscow - making measuring instrument designs and prototypes.

I would like to devote some attention to the activities of the State Hydrological Institute of whose activities I had the opportunity to become familiar in more detail. The State Hydrological Institute was created in 1919 for conducting comprehensive analyses of hydrological processes. The problems now under investigation there, are limited to surface water. According to the

present organizational structure, the following basic groups are included: hydrometry, measuring instruments, water supply, maximum discharge, lakes and marshes, hydrophysics, weather forecasting, and the dynamics of river beds. The range of problems is broad, as expressed by the number of publications which, since the establishment of the Institute, has reached a few thousand titles (2). Work plans are outlined by the Scientific Council and approved by the Central Bureau of the Hydrological-Meteorological Service. All problems, after having been investigated, are publicly discussed at sessions of the Scientific Council. The Council decides upon acceptance of a study and of its publication, in special publications of the Institute (8). It is worthwhile to note that the State Hydrological Institute employs about six persons who hold academic degrees (Doctor of Science Candidates).

Each of the previously mentioned institutes has field research stations. For example, the State Hydrological Institute supervises a laboratory in Valdai, the station in Dubovka, the hydraulic laboratory in Zelenogorsk (now under construction) and the like. A special role in the group of research centers is played by the laboratory in Valdai, which is the main experimental base in the field of surface water research in the Soviet Union. A separate article should be devoted to the work of this center which is described in detail in Uryvaev's monograph (12); we shall limit ourselves to listing below certain basic information.

The hydrological laboratory in Valdai (VNIIGL - Vsesoiuznaia Nauchno-issledavatel'skaia gidroliticheskaja laboratoria -- All Union Research Hydrological Laboratory) was established after the last war in its present form. Basic areas of the Laboratory's interest are:

- a. Research on all elements of water balance (precipitation, evaporation, discharge) in order to explain causes and interrelationships among the processes occurring in the hydrosphere.
- b. Studies on the methodology of observations on water gaging stations.
- c. Determination of characteristic regional features for the Valdai Upland.

The Laboratory also conducts intensified training of specialists by means of special practical exercises and research appointments.

The whole group of activities conducted by the All Union Research Hydrological Laboratory is conducted over an area of about 10,000 km², consisting of about 35 experimental water basins, among which are 10 supplied with permanent measuring equipment (limnographs and experimental slopes). In addition, the discharge is investigated in 16 experimental flow and water balance areas. In the area covered by the activities of the laboratory,

there is a dense network of stations for measuring precipitation (about 100 stations) and a number of other special instruments for making various measurements of the climatological factors. In total, about 500 instruments are used, of which 130 are equipped with automatic recorders. The All Union Research Hydrological Laboratory employs a few score employees, among whom are a few having higher academic degrees. On the basis of Valdai material, more than 300 studies have already been published. All results of surveys are published in full in special yearbooks of the All Union Research Hydrological Laboratory.

Shortage of space does not permit further discussion of the problem. The data presented above are of course of a fragmentary character but according to our initial intention, I would not like to trespass beyond the most generally conceived organizational structure of scientific research in hydrology. The reader who has greater interest in the problem of research may find exhaustive information in the Proceedings of the Hydrological Congress (9), which took place in Leningrad in the fall of 1957; the Congress did a review of Soviet achievements in the science of hydrology during the past 20 years.

Problem of training of cadres. Widely planned studies and surveys in the field of hydrology require the training of specialists on the middle and higher levels. It should be realized that the personnel having higher and middle training are necessary, not only in the big city centers (scientific institutes, regional bureaus of the service) but also, and maybe even principally, in the stations of the hydrological network. Cadres of those having higher education are trained mostly in the State Hydrological and Meteorological Institute in Leningrad which trains specialists in the field of meteorology, hydrology, and oceanography. Graduates from that school, which is under the supervision of the Ministry of Higher Education of the Soviet Union, obtain the degree of engineer. Similarly, the school existing until recently in Odessa, now trains only oceanographers. A small number of specialists in the field of hydrology is trained in the Department of Geography of the universities in Moscow and Leningrad, as also in the Polytechnical School in Vladivostok and in the Department of Physics of the University in Moscow. The type of training in the aforementioned institute is strongly oriented toward geophysics and great emphasis is laid on the preparation of graduates for field work.

The cadres of technicians in hydrology are trained in hydrological and meteorological technical schools maintained by the hydrological service. Programs of training were drawn up, taking into consideration the requirements of field work.

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FIGURE APPENDIX

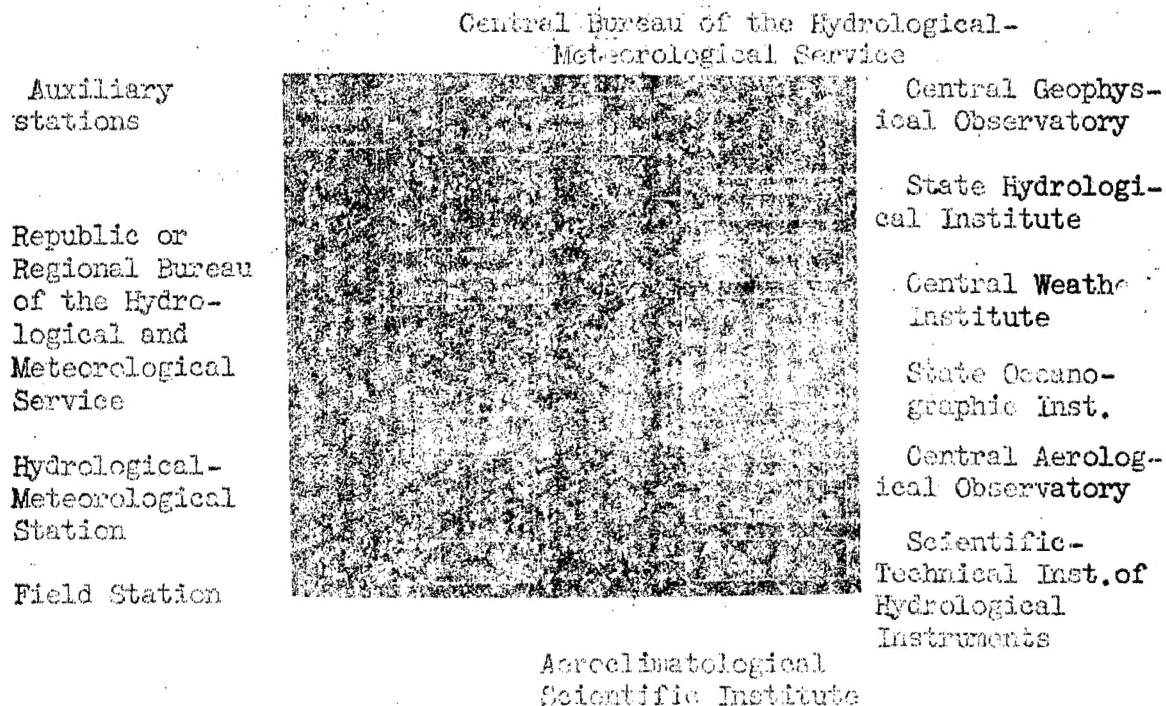
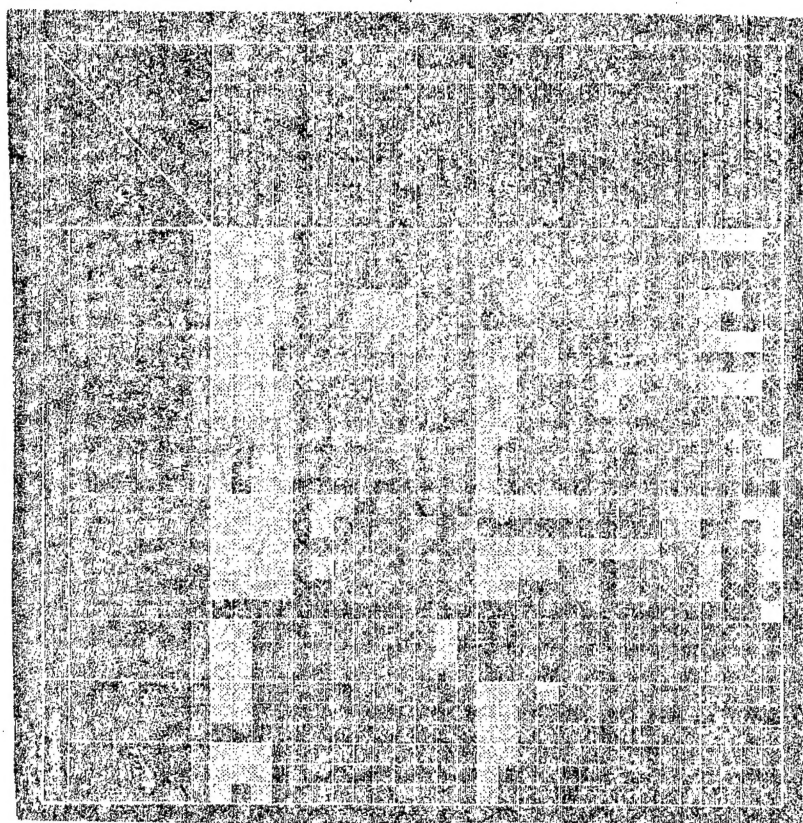


Diagram 1. General organizational scheme of the Soviet Hydrological-Meteorological Service [see Note].

[Note: It should be understood that the Central Bureau of the Hydrological-Meteorological Service consists of only three specialized departments, namely: Department of Observatories Network, Department of Weather Forecasting, and the Service to the National Economy - and the comparatively recently organized Department of Aerology. A special Autonomous Department deals with the affairs of the scientific institutes. The remaining departments and divisions included in the Central Bureau of the Hydrological-Meteorological Service are of an administrative and economic nature. (Editor's note).]



✓ Diagram 2. Classification of Soviet hydrological and meteorological stations and scope of the conducted works (according to Instructions for Hydrological and Meteorological Stations and Field Stations, Vol. 6, Leningrad, 1958).

Field station	Stations	Type of observations	
		Type of station or field station	Type of observations
Maritime	Hydrological	Meteorological Aerological Hydrological Maritime Ship Water flow measuring Agro-meteorological Estuaries Marshes Lakes Microseismical Meteorological	Atmospheric phenomena Precipitation, Snow Atmospheric temperature, Winds Atmospheric pressure, Humidity Ice Soil temperature
			Actinometry Radar Radiosonde Pilot balloons
Maritime	Hydrological	Full program Abridged program Special research	Agricultural Meteorological Hydrological
			Water temperature Water stages Underground water stages Flow of water Transportation of suspended load of sediment Composition of water Specific weight of water Observations at sea Cross-section surveys Water evaporation Evaporation from the ground Preparation of yearbooks Management of stations Management of field stations Surveys - special programs

[Translation of Diagram 2]